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EXAMINER	
HASSANZADEH, PARVIZ	
ART UNIT	**PAPER NUMBER**
1763	

DATE MAILED: 11/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/086,710	KAZUMI ET AL.	
	Examiner	Art Unit	
	Parviz Hassanzadeh	1763	

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address* --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *12-18* is/are pending in the application.

4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) *12-18* is/are rejected.

7)☐ Claim(s) ______ is/are objected to.

8)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 April 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. 08/979,949.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ______ .

4) ☐ Interview Summary (PTO-413) Paper No(s). ______ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 12-14 and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al (US Patent No. 5,556,501) in view of Schneider et al (US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022).

Collins et al teach a plasma processing apparatus (Figs. 1, 2) comprising:

an vacuum chamber upper plasma generating portion 16A (*vacuum chamber enclosing a plasma generating portion*), wherein, as shown in Fig. 1, the upper section 16A defined by a (cylindrical) dome 17 comprising a cylindrical wall 17W covered by a *top 17T* at the upper face and supported on a processing chamber top wall 13 at its lower face (column 7, lines 19-48);

a *coil antenna* 30 for generating a plasma;

a *radio-frequency power source and matching network* 31 for supplying radio-frequency electric power to the antenna (column 8, lines 4-15) (column 7, lines 19-48);

a Faraday shield 45 comprising surfaces 46-49 disposed around the walls 17W of the cylindrical source in order to ensure plasma uniformity by reducing capacitive coupling (column 15, lines 3-58);

a *gas supply unit* (not shown) connected to a gas distribution ring 51 for supplying a gas into the chamber (column 7, line 51 through column 8, line 3 and column 9, line 64 through column 10, line 11);

a wafer support 32C (*sample stage*) for supporting a wafer 5, and an AC power supply 42 (a radio-frequency power source) for applying a bias RF frequency to the wafer support 42 (column 11, lines 41-60); and

a vacuum pumping system 21 connected to a vacuum line 19 disposed at the bottom f the chamber (*a discharge unit for discharging the gas below sample stage out of the vacuum chamber*) (column 7, lines 39-45).

Collins et al fail to teach the plasma generation chamber having a trapezoidal form in a cross section; and the Faraday shield being in floating position to a ground.

Schneider et al teach a plasma reactor (Fig. 10) including a plasma generation chamber having a conical dome 130 (*trapezoidal cross section*) extending from the side of the lower chamber 106 to a position approximately over the edge of the pedestal 52. The conical dome 130 is arranged to have a larger rim at its bottom side towards the wafer processing area and a smaller rim at its top side away from the wafer processing area. The conical configuration of the wall assures good thermal contact and eliminates the air gaps present in prior art design. The use

of conical wall shape together with conically shaped induction coil windings reduces the variation in the electric field in the chamber (particularly at the center of the chamber), while the use of fixed and variable pitch coil windings can fin tune the effect of the desired electric field (column 12, line4-49).

Schneider et al further teach a Faraday shield element 272 (Fig. 18) which can be grounded or left floating so that no Ohmic voltage drop occurs in it while it is acting ad a Faraday shield (column 23, lines 44-56).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the conical configuration as taught by Schneider et al in the apparatus of Collins et al in order to reduce the variation in the electric field in the chamber particularly at the center of the chamber. Further, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield connection mechanism as taught by Schneider et al in the apparatus of Collins et al in order to be able to leave the Faraday shield grounded or floating so that no Ohmic voltage drop occurs in the shield when an RF is applied to the plasma generating inductive coil.

Collins et al and Schneider et al fail to teach the coil antenna being wound around the inclined side wall member and outside of the Faraday shield wherein a direction in which the coil antenna is wound is perpendicular to a slit provided in the Faraday shield.

Savas et al teach a plasma processing apparatus (Fig. 5) including a Faraday shield 45 conforming to the sidewall of a chamber, wherein the Faraday shield comprising conductive plates 46 spaced apart from each other forming gaps 48 therebetween such that the direction of inductive coil antenna 42 wound around the Faraday shield is perpendicular to the gaps 48 as

shown in Fig. 5. The gaps 48 are required in order to enable induction RF magnetic field to penetrate within reactor chamber. At least one gap is needed to prevent the formation of a circumferential current in the Faraday shield. Such as circumferential current would strongly oppose variation of a magnetic field within reactor chamber 50 (column 12, lines 45 through column 13,line 37).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield having gaps as taught by Savas et al in the apparatus of Collins et al in view of Schneider et al in order to enable induction RF magnetic field to penetrate within reactor chamber while preventing the formation of a circumferential current in the Faraday shield which would strongly oppose variation of a magnetic field within reactor chamber.

Further regarding claims 13, 14, 16: the apparatus of Collins et al further includes a third electrode 17T disposed in the upper section 16A, the third electrode may be floating, grounded or connected to an RF power source 40 as shown in Fig. 1, and the third electrode may have various configuration and can be made of various material such as aluminum (*conductor*) or silicon (*semiconductor*) (column 7, lines 19-38 and column 21, line 43 through column 22, line 26).

Further regarding claims 17, 18 : It was held in re Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984) that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not

perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Collins et al (US Patent No. 5,556,501) in view of Schneider et al (US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022) as applied to claims 12-14, 16-18 above, and further in view of Gorin (US Patent No. 4,464,223).

Collins et al in view of Schneider et al and Savas et al teach all limitations of the claims as discussed above except for a DC voltage source being coupled to the conductive plate (*third electrode*).

Gorin teaches a plasma processing apparatus wherein an electrode 14 may be coupled to an RF power source 36, to a DC power source 42, or being grounded through a series circuit 44 as shown in Fig. 2. use of the DC power supply allows the amount of DC biasing induced by the plasma to be changed independently of pressure or power (column 3, lines 4-63).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias power mechanism including the DC power source as taught by Gorin et al in the apparatus of Collins et al in view of Schneider et al and Savas et al in order to control the amount of bias independently of pressure or power.

Claims 12-14 and 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al (US Patent No. 5,772,771) in view of Collins et al (US Patent No. 5,556,501), Schneider et al (US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022).

Li et al teach a plasma processing apparatus (Fig. 1) comprising:

a housing 4 (*vacuum chamber enclosing a plasma generating portion*), wherein, as shown in Fig. 1, the housing 4 including a (truncated) dome 6 surrounded by the coils 8 and having its upper face covered by a top 25 (*flat and circular*) and its *bottom face* sitting on a processing chamber side wall 30;

a *coil antenna* 8 for generating a plasma;

a *radio-frequency power source 10* for supplying radio-frequency electric power to the antenna;

a *gas supply unit* (not shown) connected to a gas distribution nozzle 34 for supplying a gas into the chamber;

a substrate support 14 (*sample stage*) for supporting a substrate 20, and a bias radio-frequency power source 22 for applying a bias RF frequency to the wafer support 14; and

an exhaust port 44 disposed at the bottom f the chamber (*a discharge unit for discharging the gas below sample stage out of the vacuum chamber*) (column 20-46).

Li et al fail to teach a Faraday shield provided around the plasma generating portion.

Collins et al teach a plasma processing apparatus (Figs. 1-2) including a Faraday shield 45 in order to produce a plasma mainly inductively rather than capacitively (column 15, lines 3-58).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to employ the Faraday shield as taught by Collins et al in the apparatus of Li et al in order to generate a plasma mainly inductively.

Li et al in view of Collins et al fail to teach the Faraday shield being in floating position to a ground.

Schneider et al teach a Faraday shield element 272 (Fig. 18) which can be grounded or left floating so that no Ohmic voltage drop occurs in it while it is acting ad a Faraday shield (column 23, lines 44-56).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield connection mechanism as taught by Schneider et al in the apparatus of Li et al in view of Collins et al in order to be able to leave the Faraday shield grounded or floating so that no Ohmic voltage drop occurs in the shield when an RF is applied to the plasma generating inductive coil.

Li et al in view of Collins et al and Schneider et al fail to teach the coil antenna being wound around the inclined side wall member and outside of the Faraday shield wherein a direction in which the coil antenna is wound is perpendicular to a slit provided in the Faraday shield.

Savas et al teach a plasma processing apparatus (Fig. 5) including a Faraday shield 45 conforming to the sidewall of a chamber, wherein the Faraday shield comprising conductive plates 46 spaced apart from each other forming gaps 48 therebetween such that the direction of inductive coil antenna 42 wound around the Faraday shield is perpendicular to the gaps 48 as shown in Fig. 5. The gaps 48 are required in order to enable induction RF magnetic field to penetrate within reactor chamber. At least one gap is needed to prevent the formation of a circumferential current in the Faraday shield. Such as circumferential current would strongly oppose variation of a magnetic field within reactor chamber 50 (column 12, lines 45 through column 13,line 37).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield having gaps as taught by Savas et al in the apparatus of Li et al in view of Collins et al and Schneider et al in order to enable induction RF magnetic field to penetrate within reactor chamber while preventing the formation of a circumferential current in the Faraday shield which would strongly oppose variation of a magnetic field within reactor chamber.

Further regarding claims 1, 17, 18: It was held in re Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984) that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device.

Further, Schneider et al teach a plasma reactor (Fig. 10) including a plasma generation chamber having a conical dome 130 (*trapezoidal cross section*) extending from the side of the lower chamber 106 to a position approximately over the edge of the pedestal 52. The conical dome 130 is arranged to have a larger rim at its bottom side towards the wafer processing area and a smaller rim at its top side away from the wafer processing area. The conical configuration of the wall assures good thermal contact and eliminates the air gaps present in prior art design. The use of conical wall shape together with conically shaped induction coil windings reduces the variation in the electric field in the chamber (particularly at the center of the chamber), while the use of fixed and variable pitch coil windings can fin tune the effect of the desired electric field (column 12, line4-49).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the conical configuration as taught by Schneider et al in the apparatus of Collins et al in order to reduce the variation in the electric field in the chamber particularly at the center of the chamber.

Regarding claim 13, 14, 16: Collins et al further teach a plasma processing apparatus (Figs. 1-2) including a third electrode 17T disposed in the upper section 16A, the third electrode may be floating, grounded or connected to an RF power source 40 as shown in Fig. 1, and the third electrode may have various configuration and can be made of various material such as aluminum (*conductor*) or silicon (*semiconductor*) (column 7, lines 19-38 and column 21, line 43 through column 22, line 26).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias mechanism including the grounding as taught by Collins et al in the apparatus of Li et al in order to enhance various processing characteristic including etch rate and plasma coupling (column 21, lines 60-67).

Further regarding claim 13, 14, 16: The apparatus of Li et al further includes a top 25 acting as an anode and is electrically biased by a second RF power source 26 (column 3, lines 20-47).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al (US Patent No. 5,772,771) in view of Collins et al (US Patent No. 5,556,501) and Schneider et al (US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022) as applied to claims 12-14, 16-18 above, and further in view of Gorin (US Patent No. 4,464,223).

Li et al in view of Collins et al, Schneider et al and Savas et al teach all limitations of the claims as discussed above except for a DC voltage source being coupled to the conductive plate.

Gorin teaches a plasma processing apparatus wherein an electrode 14 may be coupled to an RF power source 36, to a DC power source 42, or being grounded through a series circuit 44 as shown in Fig. 2. Use of the DC power supply allows the amount of DC biasing induced by the plasma to be changed independently of pressure or power. Grounding will change the electrode area ratio between a high frequency electrode 12 (plasma source) and a ground electrode 26 (return path) is changed (column 3, lines 4-63).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias power mechanism including the DC power source as taught by Gorin et al in the apparatus of Li et al in view of Collins et al, Schneider et al and Savas et al in order to control the amount of bias independently of pressure or power.

Claims 12-14, 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lu et al (US Patent No. 5,904,778) in view of Collins et al (US Patent No. 5,556,501), Schneider et al (US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022).

Lu et al teach a plasma processing apparatus (Fig. 9) comprising:

a plasma generating chamber defined by side wall 74 and a top wall 80 (*vacuum chamber enclosing a portion where plasma is generated*), wherein, as shown in Fig. 8, the housing comprising a truncated conical dome 70 having an RF inductive coil 72 wrapped around its outside, and a roof 80 (*a fat upper face*), and a bottom side sitting on a processing chamber

(*inclined side wall around the portion such that the vacuum chamber has a trapezoidal form in cross-section*);

a *coil antenna* 72 for generating a plasma;

a *radio-frequency power source (not shown)* for supplying radio-frequency electric power to the antenna;

a *gas supply unit* (not shown);

a pedestal electrode 82 (*sample stage*) for supporting a wafer, and a bias radio-frequency power source 84 for applying a bias RF frequency to the wafer support 82; and

a vacuum pumping system (not shown) (*a discharge unit for discharging the gas below sample stage out of the vacuum chamber*) (column 11, line 15 through column 12, line 33).

Lu et al fail to teach a Faraday shield provided around the plasma generating portion.

Collins et al teach a plasma processing apparatus (Figs. 1-2) including a Faraday shield 45 in order to produce a plasma mainly inductively rather than capacitively (column 7, lines 19-38 and column 21, line 43 through column 22, line 26).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to employ the Faraday shield as taught by Collins et al in the apparatus of Lu et al in order to generate a plasma mainly inductively.

Lu et al in view of Collins et al fail to teach the Faraday shield being floating.

Schneider et al teach a Faraday shield element 272 (Fig. 18) which can be grounded or left floating so that no Ohmic voltage drop occurs in the shield while it is acting ad a Faraday shield (column 23, lines 44-56).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield connection mechanism as taught by Schneider et al in the apparatus of Lu et al in view of Collins et al in order to be able to leave the Faraday shield grounded or floating so that no Ohmic voltage drop occurs in the shield when an RF is applied to the plasma generating inductive coil.

Lu et al in view of Collins et al and Schneider et al fail to teach the coil antenna being wound around the inclined side wall member and outside of the Faraday shield wherein a direction in which the coil antenna is wound is perpendicular to a slit provided in the Faraday shield.

Savas et al teach a plasma processing apparatus (Fig. 5) including a Faraday shield 45 conforming to the sidewall of a chamber, wherein the Faraday shield comprising conductive plates 46 spaced apart from each other forming gaps 48 therebetween such that the direction of inductive coil antenna 42 wound around the Faraday shield is perpendicular to the gaps 48 as shown in Fig. 5. The gaps 48 are required in order to enable induction RF magnetic field to penetrate within reactor chamber. At least one gap is needed to prevent the formation of a circumferential current in the Faraday shield. Such as circumferential current would strongly oppose variation of a magnetic field within reactor chamber 50 (column 12, lines 45 through column 13,line 37).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield having gaps as taught by Savas et al in the apparatus of Lu et al in view of Collins et al and Schneider et al in order to enable induction RF magnetic field to penetrate within reactor chamber while preventing the formation of a circumferential

current in the Faraday shield which would strongly oppose variation of a magnetic field within reactor chamber.

Regarding claims 13, 14, 16: Collins et al further teach a plasma processing apparatus (Figs. 1-2) including a third electrode 17T disposed in the upper section 16A, the third electrode may be floating, grounded or connected to an RF power source 40 as shown in Fig. 1, and the third electrode may have various configuration and can be made of various material such as aluminum (*conductor*) or silicon (*semiconductor*) (column 7, lines 19-38 and column 21, line 43 through column 22, line 26).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias mechanism including the bias RF power source as taught by Collins et al in the apparatus of Lu et al in order to enhance various processing characteristic including etch rate and selectivity (column 22, lines 1-26).

Further regarding claim 13, 14, 16: the top wall 80 is grounded (column 11, line 15 through column 12, line 33).

Further regarding claims 17, 18: It was held in re Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984) that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lu et al (US Patent No. 5,904,778) in view of Collins et al (US Patent No. 5,556,501) and Schneider et al

(US Patent No. 6,308,654 B1) and Savas et al (US Patent No. 5,811,022) as applied to claims 12-14, 16-18 above, and further in view of Gorin (US Patent No. 4,464,223).

Lu et al in view of Collins et al, Schneider et al and Savas et al teach all limitations of the claims as discussed above except for a DC voltage source is coupled to the conductive plated.

Gorin teaches a plasma processing apparatus wherein an electrode 14 may be coupled to an RF power source 36, to a DC power source 42, or being grounded through a series circuit 44 as shown in Fig. 2. Use of the DC power supply allows the amount of DC biasing induced by the plasma to be changed independently of pressure or power. Grounding will change the electrode area ratio between a high frequency electrode 12 (plasma source) and a ground electrode 26 (return path) is changed (column 3, lines 4-63).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias power mechanism including the DC power source as taught by Gorin et al in the apparatus of Lu et al in view of Collins et al, Schneider et al and Savas et al in order to control the amount of bias independently of pressure or power.

Claims 12, 17, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lu et al (US Patent No. 5,904,778) in view of Savas et al (US Patent No. 5,811,022).

Lu et al teach a plasma processing apparatus (Fig. 9) comprising:

a plasma generating chamber defined by side wall 74 and a top wall 80 (*vacuum chamber enclosing a portion where plasma is generated*), wherein, as shown in Fig. 8, the housing comprising a truncated conical dome 70 having an RF inductive coil 72 wrapped around its outside, and a roof 80 (*a fat upper face*), and a bottom side sitting on a processing chamber

(*inclined side wall around the portion such that the vacuum chamber has a trapezoidal form in cross-section*);

a *coil antenna* 72 for generating a plasma;

a *radio-frequency power source (not shown)* for supplying radio-frequency electric power to the antenna;

a *gas supply unit* (not shown);

a pedestal electrode 82 (*sample stage*) for supporting a wafer, and a bias radio-frequency power source 84 for applying a bias RF frequency to the wafer support 82; and

a vacuum pumping system (not shown) (*a discharge unit for discharging the gas below sample stage out of the vacuum chamber*) (column 11, line 15 through column 12, line 33).

Lu et al fail to teach a Faraday shield provided around the plasma generating portion, wherein the shield is at a floating potential and wherein the coil antenna being wound around the inclined side wall member and outside of the Faraday shield wherein a direction in which the coil antenna is wound is perpendicular to a slit provided in the Faraday shield.

Savas et al teach a Faraday shield element 64 (Figs. 10, 11) disposed between an induction coil 42 and a plasma generation chamber 41 in order to reduce capacitive coupling between the antenna coil and the plasma, wherein the Faraday shield 64 may be grounded through an adjustable impedance Zs (column 19, line 22-63). Savas et al further teach the Faraday shield 45 conforming to the sidewall of a chamber, wherein the Faraday shield comprising conductive plates 46 spaced apart from each other forming gaps 48 therebetween such that the direction of inductive coil antenna 42 wound around the Faraday shield is perpendicular to the gaps 48 as shown in Fig. 5. The gaps 48 are required in order to enable

induction RF magnetic field to penetrate within reactor chamber. At least one gap is needed to prevent the formation of a circumferential current in the Faraday shield. Such as circumferential current would strongly oppose variation of a magnetic field within reactor chamber 50 (column 12, lines 45 through column 13,line 37).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield mechanism as taught by Savas et al in the apparatus of Lu et al in order to reduce capacitive coupling. It further would have been obvious to one of ordinary skill in the art at the time of the invention to implement the Faraday shield having gaps as taught by Savas et al in Fig. 5 in the apparatus of Lu et al in order to enable induction RF magnetic field to penetrate within reactor chamber while preventing the formation of a circumferential current in the Faraday shield which would strongly oppose variation of a magnetic field within reactor chamber.

Further regarding claims 17, 18: It was held in re Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984) that where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device.

Claims 13, 14, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lu et al (US Patent No. 5,904,778) in view of Savas et al (US Patent No. 5,811,022) as applied to claims 12, 17, 18 above, and further in view of Collins et al (US Patent No. 5,556,501).

Lu et al in view of Savas et al teach all limitations of the claims as discussed above except for a plate made of a conductor or semiconductor and placed on an inner side of the upper face of the vacuum chamber.

Collins et al teach a plasma processing apparatus (Figs. 1-2) including a third electrode 17T disposed in the upper section 16A, the third electrode may be floating, grounded or connected to an RF power source 40 as shown in Fig. 1, and the third electrode may have various configuration and can be made of various material such as aluminum (*conductor*) or silicon (*semiconductor*) (column 7, lines 19-38 and column 21, line 43 through column 22, line 26).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias mechanism including the bias RF power source as taught by Collins et al in the apparatus of Lu et al in view of Savas et al in order to enhance various processing characteristic including etch rate and selectivity (column 22, lines 1-26).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lu et al (US Patent No. 5,904,778) in view of Savas et al (US Patent No. 5,811,022) and Collins et al (US Patent No. 5,556,501) as applied to claims 12-14, 16-18 above, and further in view of Gorin (US Patent No. 4,464,223).

Lu et al in view of Savas et al and Collins et al teach all limitations of the claims as discussed above except for a DC voltage source is coupled to the conductive plated.

Gorin teaches a plasma processing apparatus wherein an electrode 14 may be coupled to an RF power source 36, to a DC power source 42, or being grounded through a series circuit 44 as shown in Fig. 2. Use of the DC power supply allows the amount of DC biasing induced by the plasma to be changed independently of pressure or power. Grounding will change the electrode

area ratio between a high frequency electrode 12 (plasma source) and a ground electrode 26 (return path) is changed (column 3, lines 4-63).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to implement the bias power mechanism including the DC power source as taught by Gorin et al in the apparatus of Lu et al in view of Savas and Collins et al in order to control the amount of bias independently of pressure or power.

Response to Arguments

Applicant's arguments filed 10/6/03 have been fully considered but they are not persuasive.

Applicants assert that neither of the prior art relied upon in rejection of claims 12-18 teach the coil antenna being wound around the inclined side wall member and outside of the Faraday shield wherein a direction in which the coil antenna is wound is perpendicular to a slit provided in the Faraday shield.

The Examiner has revised the rejection using Savas et al for teaching a Faraday shield 45 conforming to the sidewall of a chamber, wherein the Faraday shield comprising conductive plates 46 spaced apart from each other forming gaps 48 therebetween such that the direction of inductive coil antenna 42 wound around the Faraday shield is perpendicular to the gaps 48 as shown in Fig. 5.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following arts disclose plasma processing apparatus including a plasma

generating portion having an upper face having a smaller area than a lower face thereof wherein the upper faces is flat and an angle between the side faces of the plasma generating portion and a normal to the upper face having an angle more than 5 degrees and wherein the ration of the height of the plasma generating position to the radius of the upper face may be equal or less than one. Yoshioka et al (US Patent No. 6,034,346) (Fig. 3b); Cui et al (US Patent No. 5,965,463) (Figs. 2-3); Murugesh et al (US Patent No. 5,811,356) (Fig. 1); Nowak et al (US Patent No. 5,865,896) (Fig. 1); Yin et al (US Patent No. 5,540,824) (Fig. 2D); Ye et al (US Patent No. 6,071,372) (Figs. 4E, 4F); and Horioka et al (US Patent No. 6,132,551).

Collins (US Patent No. 6,036,878) disclose the employment of a Faraday shield in different location of a plasma processing chamber; Daviet (US Patent No. 6,056,848) teach a Faraday shield (Fig. 2) which may be grounded or being left floating; and Fairbairn et al (US Patent No. 5,614,055) teach a Faraday shield conformed to the shape o the chamber top and having gaps between conductive section of the Faraday shield in a direction perpendicular to the direction of the inductive coil winding.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Parviz Hassanzadeh whose telephone number is (703)308-2050 or (571)272-1435. The examiner can normally be reached on Tuesday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Gregory Mills can be reached on (703)308-1633. The fax phone number for the organization where this application or proceeding is assigned is (703)872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0661.

P. Hassanzadeh
Parviz Hassanzadeh
Primary Examiner
Art Unit 1763

November 12, 2003